UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
1110 West Washington Street
Phoenix, Arizona 85007

Phil Mook
Western Execution Branch Chief
Department of the Air Force
AFCEC/CIBW
3411 Olson Street
McClellan, CA 95652

Re: Approval and Implementation of Revised Draft Final Addendum #2 Remedial Design and Remedial Action Work Plan for Operable Unit 2, Revised Groundwater Remedy, Site ST012, Former Williams AFB

Dear Mr. Mook:

The U.S. Environmental Protection Agency (EPA) and the Arizona Department of Environmental Quality (AZDEQ) (hereafter the Regulatory Agencies) are reviewing the above-mentioned document to determine if the proposed remedial action is acceptable for implementation at the ST012 Site.

Conceptually, sulfate reduction (i.e., enhanced sulfate reduction/enhanced bioremediation (EBR) using injected sulfate as an electron acceptor, and afterwards monitored natural attenuation [MNA] relying on natural sulfate reduction) seems likely to be useful for degradation of the contaminants of concern (COCs) dissolved in groundwater over time. However, given the considerable mass of source material (both mobile and residual light nonaqueous phase liquid [LNAPL]) remaining at Site ST012, the practical efficacy of EBR/MNA towards achieving Site remedial goals in the timeframe established in the 2013 Final Record of Decision Amendment 2 (2013 RODA 2) Groundwater, Operable Unit 2 is highly uncertain from the Agencies' perspective. The Regulatory Agencies have independently developed modeled estimates of time to remediation for EBR that exceed a century, based upon Air Force's (AF's) remaining mass estimates. This was not the intent of the remedy selected in the 2013 RODA 2, which provided the expectation of a remedial timeframe to meet remedial action objectives within 20 years.

The 2013 Record of Decision selected Steam Enhanced Extraction (SEE) to be followed by Enhanced Bioremediation. As stated ~~in the~~ in the original draft proposed plan dated January 4, 2013, *"After most of the LNAPL is removed by SEE, the remedy would transition to Enhanced Bioremediation"* to meet the remedial action objective. This documents a common understanding amongst the AF and Regulatory Agencies' project team at the time that the bulk of the mass of ~~free product~~ NAPL needed to be removed first to enable biodegradation of ~~residual~~ remaining contamination within the 20 year timeframe as the purpose of first implementing SEE. This was always the expectation of the regulatory agencies, and the reason why performance criteria for transition of the remedy to EBR was established in the original RDRA workplan. However, at the time the SEE was terminated and dismantled, the criteria

Commented [WU1]: estimates of contaminant mass remaining

Commented [WU2]: "free product" could be taken as referring to mobile NAPL.

Commented [WU3]: Not just residual, but both residual and mobile NAPL.

established in the workplan documents had not been attained. Remaining groundwater benzene concentrations in the 1000's of ug/l~~parts per billion~~ greatly exceed the 100 -500 ug/l specified as transition criterion in the workplan for EBR to meet the timeframe specified in the 2013 RODA 2. The criterion for mass removal of less than 10 percent of peak recovery rate was also not attained as vapor recovery alone was around 25 percent of peak recovery rate with around 3000 lbs. recovered per day, in addition to thousands of gallons of LNAPL also being recovered. The criterion for steam injection was also only 94% of the projected budget for the project, representing less than the projected 1.6 pore volume of flushing originally planned for.

Based upon the operational data from the SEE and estimates of mass remaining, it appears that the SEE system design and operation was not sufficient to achieve the SEE system remedial goals, and bring the site into a condition suitable for implementation of EBR/MNA. Under-estimation of the total mass of LNAPL, and the full extent of the area needing to be treated, is related to the insufficiency of the SEE implementation to meet remedial goals, and continues to contribute to difficulties with remedial design and operations. *This underscores the importance of obtaining good baseline characterization prior to design of the remedy.*

Commented [WU4]: Or, "incomplete characterization"

The Regulatory Agencies invoked informal dispute on the basis that 1) transition to EBR is premature due to transition criteria specified in the original workplan not being achieved and 2) the estimated ~~of~~ contaminant mass remaining is too high to allow EBR/MNA meet the objectives in the ROD. Nevertheless, AF has indicated their desire to proceed with EBR at this time. Because t~~T~~he ability of EBR to remediate potentially nine~~s~~ million pounds of remaining LNAPL is questionable, ~~warrants~~ additional pilot testing is warranted~~:~~ to collect essential site specific information to inform the full-scale design, if the remedy is to be successful.

The Regulatory Agencies understand that the Air Force wants to initiate EBR as described in the July 2017 RDRA Work Plan to begin addressing subsurface contamination at the site and to obtain data on which to base future contracts. The agencies strongly support characterization as critical to a successful future contracting strategy for the site, as well as to provide a baseline for monitoring remedy success.

The Agencies remain unconvinced that EBR will be effective at achieving remediation goals within the timeframe identified in the Work Plan, and we do not believe that the Work Plan as proposed will provide the data required in order to determine if EBR is working as intended. The July 2017 workplan as submitted remains unlikely to generate the information AF is expecting to be able to evaluate remedy effectiveness and to inform future procurements. However, we are willing to support the AF's proposal, provided the critical elements listed below are satisfactorily addressed in the work plan.

1. Site Characterization:

a) The Site must be adequately characterized, including the extent of dissolved benzene in excess of the cleanup criteria, the extent of LNAPL and the COC content of the LNAPL, and the remaining mass of contaminants within the thermal treatment zone, for each of the three vertical zones.

b) Complete EBR baseline data from each zone must also be collected, validated, analyzed, and reported prior to initiating EBR. Microbial and geochemical data collected prior to the initiation of SEE or during SEE are not considered representative of current site conditions.

2. Plan for Evaluation of Remedy Performance:

a) AF must demonstrate that EBR implementation as planned can achieve remedial goals by the timeframe set forth in the 2013 RODA 2 using a predictive model and defensible input parameters, and using initial mass estimates developed based on the new data derived from the a complete characterization of the site summarized in item a) above..

b) Estimates for the time of remediation (TOR) must be provided for each of the three zones (CZ, UWBZ and LSZ). The revised draft final addendum did not include any supporting data or calculations to indicate sulfate reduction as designed would achieve remedial goals in the desired timeframe.

c) Specific milestones (e.g., benzene concentration in LNAPL of XX at YY time after EBR implementation) based on COC concentrations in the site groundwater and LNAPL must be developed as derived from predictive modeling of COC attenuation over time.

d) The predictive modeling will require field tests of EBR conducted in the CZ and UWBZ to determine degradation rates in these hydrologic zones. Field tests of EBR in the UWBZ were specified in the Final Remedial Design and Remedial Action Work Plan (Amec, 2014) to take place before completing the EBR design, but these field tests have not been completed.

Commented [WU5]: Note that AMEC/AF will just reply that the "phased implementation" they propose would be the field tests we're asking for, and I suspect that upper levels of management would agree with them.

3. Plan for Monitoring

Set forth a monitoring plan and remedy success criteria (to be developed in conjunction with the Agencies) necessary to evaluate the success of the remedy following implementation.

a) Monitoring wells not used for injection ~~and~~ or extraction must be used as the primary source of data for determining contaminant degradation; each of the 32 treatment ovals for full scale EBR implementation identified on the attached figure from the May BCT presentation must have at least ~~1~~ one dedicated monitoring well (i.e., not used for injection or extraction) to evaluate remedy effectiveness in that location.

b) Monthly monitoring of sulfate concentrations must be conducted in monitoring wells for the first 12 months after the initiation of sulfate injection, ~~and report c~~Comparisons between model predictions and measures of sulfate concentration in monitoring wells should be reported monthly (e.g., graph the predicted sulfate concentration at each monitoring well and the field measures of sulfate in that monitoring well as a function of time).

c) Monitoring will also include consistent and frequent site-wide monitoring of COC concentrations in LNAPL and in groundwater. ~~Where~~ In site locations where LNAPL

cannot be collected from monitoring wells, soil cores must be obtained to collect this data from LNAPL-contaminated regions. This data is critical to evaluate the claim that EBR can remediate BTEX contained in LNAPL, and to evaluate the progress of the site to achieving the milestones developed from the predictive modeling.

4. Containment for Long Term Protectiveness

Ensure that the plume of contaminated groundwater and the injected TEA is controlled and that downstream drinking water sources are protected by providing recirculation during TEA injection and for a time period thereafter, as was called for in the approved May 2014 OU2 Remedial Work Plan.

The Regulatory Agencies acknowledge and appreciate AF's commitment as stated in the workplan cover letter, *"If recalcitrant areas of contamination exist three to 5 years post -EBR implementation, nominally, 10 years before the estimated time to complete, optimized or alternate remedial action, potentially including focused SEE will be evaluated, and, if appropriate, implemented in coordination with EPA and ADEQ."* It is therefore critical that specific milestones be clearly established in the workplan to enable this determination. The July 2017 Addendum 2 workplan does not establish criteria for evaluating remedy success or determining whether alternate remedial action is warranted.

We also agree with the statement that *"the time period from 2017 to 2020 as* (sic) *critical for the implementation of EBR in specific, and the efficacy of the ST012 remedy in general".* The Agencies also believe the data elements listed above are essential to enabling the AF to evaluate the remedy effectiveness going forward, but these data elements are not provided in the July 2017 workplan. As a result, we remain unconvinced that the proposed approach will generate data useful for evaluating the effectiveness of the remedy or for informing future contract procurement.

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The Agencies have repeatedly raised these aforementioned concerns in many formats over the past two years to no avail, which is not in line with AF's commitment to working cooperatively and in good faith with the Agencies. We suggest a technical meeting to discuss incorporating these elements into the final workplan. The Regulatory Agencies are committed to supporting AF in the remediation of the site. However, if the Air Force or their contractor is unwilling or unable to incorporate these critical elements into the workplan, then we will have no option but to invoke formal dispute per the Federal Facility Agreement resulting in considerable project delay.

Sincerely,

Angeles Herrera
Assistant Director
Superfund Division
US Environmental Protection Agency

Tina La Page
Waste Programs Division
Remedial Projects Section Manager
Arizona Department of Environmental Quality

Attachment

ST12 Addendum 2 Workplan Characterization Needs:

Additional Monitoring wells needed because:

1. A Pilot Test that did not generate ROI or travel time information
2. The lack of hydraulic information for the CZ
3. Unusual injection well (IW) – Extraction Well (EW) configurations. In some cases, there are 2, 3 or 4 IWs for a single EW. If sulfate is detected in the associated EW, which IW did it come from? In other cases, the EWs are cross-gradient or up-gradient of the associated IW(s).
4. The distance between IW/EW pairs
5. The fact that Addendum #2 indicates that the EWs will be turned off once sulfate reaches them. In cases where there are cross-gradient or downgradient IWs, this means that natural groundwater flow will distribute the sulfate in the downgradient direction (i.e., not toward the EW).

CZ - Four additional monitoring wells:

- Between ST012-CZ12 and ST012-CZ21 (Cross-gradient extraction well)
- Between ST12-CZ16 and ST12-CZ21
- East of ST012-CZ12 (Downgradient to evaluate sulfate dispersion in the downgradient direction since the associated extraction well is cross-gradient to the groundwater flow direction)
- Between ST012-SVE04 DEEP and ST012-CZ18 (Cross-gradient extraction well)

UWBZ – 11 additional monitoring wells. There are no monitoring wells between any injection well/extraction well pair:

- Between ST12-UWBZ36 and ST012-UWBZ26 (ROI, travel time)
- Between ST12-UWBZ35 and ST012-UWBZ27 (ROI, travel time)
- Between ST12-UWBZ35 and ST012-UWBZ26 (ROI, travel time)
- Between ST12-UWBZ34 and ST012-UWBZ27 (ROI, travel time)
- Between ST12-UWBZ33 and ST012-UWBZ22 (ROI; No monitoring between this well pair)
- Between ST12-UWBZ32 and ST012-UWBZ22 (ROI; Cross-gradient extraction proposed)
- Between ST12-UWBZ16 and ST012-UWBZ22 (ROI; Extraction well is upgradient of injection well. As such, it is unclear if the upgradient extraction well will be effective. Extraction well serves three injection wells.)
- Between ST12-UWBZ28 and ST012-UWBZ10 (ROI; Extraction well is upgradient/cross-gradient of injection well. As such, it is unclear if the upgradient/cross-gradient extraction well will be effective.)
- Between ST12-UWBZ12 and ST012-UWBZ30 (ROI, travel time)

- Between ST12-UWBZ29 and ST012-UWBZ30 (ROI; Cross-gradient extraction well; Extraction well serves two injection wells)
- Between ST12-UWBZ12 and ST012-UWBZ21 (Cross-gradient extraction well)
- East (downgradient) of ST012-UWBZ12 to evaluate sulfate dispersion

LSZ – 21 additional monitoring well needed. There are only two injection/extraction well pairs with a monitoring well located between them.

- Between ST012-W30 and ST012-LSZ37 (ROI; travel time; Extraction well serves two injection wells.)
- Between ST012-LSZ08 and ST012-LSZ37 (ROI; Extraction well is upgradient of the injection well. As such, it is unclear if the upgradient extraction well will be effective.)
- Between ST012-LSZ17 and ST012-LSZ51 (ROI; Extraction well is cross-gradient of the injection well and there is a downgradient extraction well. As such, it is unclear if sulfate will be distributed to the north.)
- Between ST012-LSZ17 and ST012-LSZ28 (ROI; Second extraction well for this injection well; No monitoring wells to evaluate sulfate distribution percentage to east.)
- Between ST012-LSZ28 and ST012-LSZ43 (ROI; Extraction well is upgradient and cross-gradient. As such, it is unclear if the upgradient/cross-gradient extraction well will be effective; Injection well is associated with a second extraction well to the southeast.)
- Between ST012-LSZ43 and ST012-LSZ29 (This extraction well serves four injections wells. As such, it is unclear if it will be effective, given the distances and directions to the injection wells)
- Between ST012-W36 and ST012-LSZ29 (ROI; Extraction well is cross-gradient; Extraction well is shared with three other injection wells.)
- Between ST012-LSZ44 and ST012-LSZ29 (Extraction well is upgradient. As such, it is unclear if the upgradient extraction well will be effective; Extraction well is shared with four injection wells.)
- Between ST012-W34 and ST012-LSZ29 (Extraction well is upgradient and 265 feet from injection well. As such, it is unclear if the upgradient extraction well will be effective.)
- East of ST012-LSZ44 (Evaluate downgradient sulfate dispersion)
- East of ST012-W34 (Evaluate downgradient sulfate dispersion)
- East of ST012-W36 (Evaluate downgradient dispersion)
- Between ST012-LSZ50 and ST012-LSZ09 (ROI; travel time; Injection well shared by two extraction wells)
- Between ST012-LSZ50 and ST012-LSZ328 (ROI; travel time; Injection well shared by two extraction wells)
- Between ST012-LSZ49 and ST012-LSZ38 (Three extraction wells are designated for a single injection well. As such, it is unclear what direction sulfate will be dispersed; Evaluate percentage of distribution)
- Between ST012-LSZ49 and ST012-LSZ23 (2^{nd} of three extraction wells designated for a single injection well; Evaluate percentage of distribution)
- Between ST012-LSZ49 and ST012-LSZ39 (3^{rd} of three extraction wells for a single injection well; Evaluate percentage of distribution)
- Between ST012-LSZ47 and ST012-LSZ11 (ROI; Cross-gradient extraction well)
- Between ST012-LSZ46 and ST012-LSZ12 (ROI; Cross-gradient extraction well; Extraction well shared by three injection wells; Evaluate effectiveness)
- Between ST012-W37 and ST012-LSZ12 (ROI; Cross-gradient extraction well; Extraction well shared by three injection wells; Evaluate effectiveness)
- Between ST012-LSZ45 and ST012-LSZ12 (ROI; Upgradient extraction well shared by three injection wells. As such, it is unclear if the upgradient extraction well will be effective.)